

Listing of Claims:

1. (Previously Presented) A device for transmitting and receiving signals over a communications line, comprising:

a transmitter circuit having an output coupled to the communications line for transmitting signals in a first bandwidth;

a receiver circuit having an input coupled to the communications line for receiving signals in a second, non-overlapping, bandwidth; and

a hybrid circuit connected to the transmitter circuit output, the receiver circuit input and the communications line, the hybrid circuit being configured as a voltage divider formed from reactive elements for substantially canceling first bandwidth signals transmitted by the transmitter circuit from appearing with second bandwidth signals at the receiver input and for further filtering out signals received from the communications line at frequencies that fall within the first bandwidth.

2. (Original) The device of claim 1, wherein:

the hybrid circuit comprises a first order filter.

3. (Original) The device of claim 1, wherein:

the hybrid circuit comprises a high pass filter.

4. (Previously Presented) The device of claim 1, wherein:

the hybrid circuit is configured as a capacitive divider for scaling the first bandwidth signals at the transmitter output for cancellation with related first bandwidth signals appearing on the communications line.

5. (Previously Presented) The device of claim 4, wherein the hybrid circuit comprises:

a first capacitor having a first terminal connected to the communications line and a second terminal;

a second capacitor having a first terminal connected to the transmitter circuit output and a second terminal connected to the second terminal of the first capacitor; and

a resistor having a first terminal connected to the second terminal of the first capacitor and a second terminal connected to a reference voltage.

6. (Original) The device of claim 5, wherein:

the ratio between the capacitance of the first capacitor to the capacitance of the second capacitor is substantially the same as the ratio between the voltage level at the transmitter output to the voltage level of a related signal appearing on the communications line.

7. (Previously Presented) The device of claim 1, wherein:

the communications line comprises a differential pair of communications lines;
the transmitter output is a differential output;
the receiver input is a differential input; and

the hybrid circuit comprises a first filter circuit having a first terminal connected to a first line of the differential pair of communications lines, a second terminal connected to a first line of the differential output of the transmitter circuit and a third terminal connected to a first line of the differential input of the receiver circuit, the first filter circuit being configured as a voltage divider formed from reactive elements for substantially canceling first bandwidth signals transmitted by the transmitter circuit and appearing on the first terminal of the differential output thereof from appearing at the first line of the differential input of the receiver circuit.

8. (Previously Presented) The device of claim 7, wherein:

the hybrid circuit further comprises a second filter circuit having a first terminal connected to a second line of the differential pair of communications lines, a second terminal connected to a second line of the differential output of the transmitter circuit and a third terminal connected to a second line of the differential input of the receiver circuit, the second filter circuit being configured as a voltage divider formed from reactive elements for substantially canceling first bandwidth signals transmitted by the transmitter circuit and appearing on the second terminal of the differential output thereof from appearing at the second line of the differential input of the receiver circuit.

9. (Original) The device of claim 8, wherein:
the second filter circuit forms a capacitive divider.
10. (Previously Presented) The device of claim 8, wherein:
the second filter circuit comprises a pair of series connected capacitors connected between the second line of the differential pair of communications lines and the second line of the differential output of the transmitter circuit, and a resistor having a first terminal connected to each of the capacitors and a second terminal connected to a reference voltage.
11. (Original) The device of claim 8, wherein:
the second filter circuit comprises a first order, high pass filter.
12. (Original) The device of claim 8, wherein:
the first filter circuit and the second filter circuit each comprise a first order high pass filter.
13. (Original) The device of claim 7, wherein:
the first filter circuit forms a capacitive divider.
14. (Previously Presented) The device of claim 7, wherein:
the first filter circuit comprises a pair of series connected capacitors connected between the first line of the differential pair of communications lines and the second line of the differential output of the transmitter circuit, and a resistor having a first terminal connected to each of the capacitors and a second terminal connected to a reference voltage.
15. (Previously Presented) The device of claim 1 further comprising an amplifier circuit configured as an inverting amplifier that is connected between the transmitter circuit output and the hybrid circuit, the amplifier circuit and the hybrid circuit generating a first scaled output voltage signal and a second scaled voltage signal which cancel each other at the receiver circuit input.

16. (Previously Presented) A hybrid circuit associated with an end of a telecommunications line to which a DSL transmitter and a receiver are connected, comprising:

a first circuit having a first terminal coupled to an output of the DSL transmitter which transmits DSL signals in a first bandwidth, a second terminal coupled to an input of the DSL receiver which receives DSL signals in a second, non-overlapping, bandwidth and a third terminal coupled to the telecommunications line, for canceling first bandwidth signals transmitted by the DSL transmitter from appearing with second bandwidth DSL signals at the DSL receiver input and filtering first bandwidth DSL signals received from the telecommunications line from appearing at the DSL receiver input so that the DSL receiver is substantially isolated from the DSL transmitter, the first circuit forming a voltage divider of reactive elements that is configured as a filter.

17. (Original) The hybrid circuit of claim 16, wherein:

the first circuit comprises a high pass filter.

18. (Original) The hybrid circuit of claim 16, wherein:

the first circuit capacitively scales signals appearing at the output of the transmitter and on the telecommunications line so as to substantially cancel common signals therebetween.

19. (Original) The hybrid circuit of claim 18, wherein:

the first circuit is configured as a high pass filter.

20. (Original) The hybrid circuit of claim 18, wherein the first circuit comprises:

a first capacitor having a first terminal connected to the telecommunications line and a second terminal;

a second capacitor having a first terminal connected to the transmitter output and a second terminal connected to the second terminal of the first capacitor; and

a resistor connected between to the second terminal of the first capacitor and a reference voltage.

21. (Original) The hybrid circuit of claim 20, wherein:
the ratio between the capacitance value of the first capacitor to the capacitance value of the second capacitor is substantially the same as the voltage swing of signals at the transmitter output to the voltage swing of related signals appearing on the telecommunications line.
22. (Previously Presented) The hybrid circuit of claim 16, further comprising:
a second circuit configured as an inverting amplifier, the second circuit connected between the transmitter output and an input of the first circuit.

23. (Previously Presented) A hybrid circuit associated with an end of a two wire telecommunications line to which a transmitter and a receiver are connected, comprising:

a first circuit having a first terminal coupled to a differential output of the transmitter, a second terminal coupled to a differential input of the receiver and a third terminal coupled to the telecommunications line, for canceling signals transmitted by the transmitter from appearing at the receiver input and filtering signals at predetermined frequencies received from the telecommunications line from appearing at the receiver input so that the receiver is substantially isolated from the transmitter, the first circuit forming a voltage divider of reactive elements that is configured as a filter;

the first terminal of the first circuit is connected to a first line of the transmitter output, the second terminal of the first circuit is connected to a first line of the receiver input, and the third terminal of the first circuit is connected to a first line of the telecommunications line; and

the hybrid circuit further comprises a second circuit having a first terminal connected to a second line of the transmitter output, a second terminal connected to a second line of the receiver input, and a third terminal connected to a second line of the telecommunications line, for canceling signals relating to signals generated by the transmitter and appearing at the second line of the receiver input, and for filtering signals on the second telecommunications line at predetermined frequencies from appearing at the second line of the receiver input, the second circuit forming a voltage divider of reactive elements that is configured as a filter.

24. (Previously Presented) The hybrid circuit of claim 23, wherein:

the second circuit capacitively scales signals appearing at the second output line of the transmitter and signals appearing on the second telecommunications line so that common signals therebetween cancel at the second line of the receiver input.

25. (Previously Presented) A hybrid circuit associated with an end of a telecommunications line to which a DSL transmitter and a DSL receiver are connected, comprising:

a first filter circuit connected to an output of the DSL transmitter which transmits DSL signals in a first bandwidth, the telecommunications line and an input of the DSL receiver which receives DSL signals in a second, non-overlapping, bandwidth, for filtering first bandwidth DSL signals appearing on the transmitter output and received from the telecommunications line, scaling first bandwidth DSL signals appearing on the transmitter output, and canceling related first bandwidth DSL signals with the scaled first bandwidth DSL signals to prevent the related first bandwidth DSL signals from appearing with second bandwidth DSL signals received from ~~on~~ the telecommunications line at the DSL receiver.

26. (Previously Presented) A hybrid circuit associated with an end of a telecommunications line to which a transmitter and a receiver are connected, comprising:

a first filter circuit connected to an output of the transmitter, the telecommunications line and an input of the receiver, for filtering signals at predetermined frequencies appearing on the transmitter output and received from the telecommunications line, scaling signals appearing on the transmitter output, and canceling the scaled signals at the receiver input with related signals appearing on the telecommunications line, wherein:

the first filter circuit includes a first reactive component connected between the telecommunications line and the receiver input, a first electrical component connected between the transmitter output and the receiver input, and a second electrical component connected between the receiver input and a reference voltage.

27. (Original) The hybrid circuit of claim 25, wherein:
the first filter circuit is configured as a capacitive divider.

28. (Original) The hybrid circuit of claim 27, wherein:
the first filter circuit forms a high pass filter.

29. (Original) The hybrid circuit of claim 27, wherein:
the first filter circuit includes a first capacitor connected to the transmitter output, a second capacitor connected to the telecommunications line and a resistor connected to the first and second capacitors.

30. (Original) The hybrid circuit of claim 29, wherein:
the ratio of the capacitance value of the first capacitor to the capacitance value of the second capacitor is substantially the same as the voltage swing of the signals appearing on the transmitter output to the voltage swing of the related signals appearing on the telecommunications line.

31. (Original) The hybrid circuit of claim 25, wherein:
the first filter circuit forms a low pass filter.

32. (Previously Presented) A device for transmitting and receiving signals over a communications line, comprising:

a transmitter circuit having an output coupled to the communications line;

a receiver circuit having an input coupled to the communications line; and

a hybrid circuit connected to the transmitter output, the receiver input and the communications line, for filtering signals at frequencies that fall outside of a predetermined frequency range, the hybrid circuit being configured as a capacitive divider for scaling the signals at the transmitter output for cancellation with related signals appearing at the receiver input, the capacitive divider comprising:

a first capacitor having a first terminal connected to the communications line and a second terminal;

a second capacitor having a first terminal connected to the transmitter output and a second terminal connected to the second terminal of the first capacitor; and

a resistor having a first terminal connected to the second terminal of the first capacitor and a second terminal connected to a reference voltage.

33. (Previously Presented) The device of claim 32, wherein:

the ratio between the capacitance of the first capacitor to the capacitance of the second capacitor is substantially the same as the ratio between the voltage level at the transmitter output to the voltage level of a related signal appearing on the communications line.

34. (Previously Presented) A device for transmitting and receiving signals over a differential communications line, comprising:

a transmitter circuit having a differential output coupled to the differential communications line;

a receiver circuit having a differential input coupled to the differential communications line; and

a hybrid circuit connected to the transmitter differential output, the receiver differential input and the differential communications line, the hybrid circuit comprises a first filter circuit having a first terminal connected to a first line of the differential communications line, a second terminal connected to a first line of the differential output of the transmitter circuit and a third terminal connected to a first line of the differential input of the receiver circuit, the first filter circuit being configured as a voltage divider formed from reactive elements for substantially canceling signals transmitted by the transmitter circuit and appearing on the first line of the differential output thereof from appearing at the first line of the differential input of the receiver.

35. (Previously Presented) The device of claim 34, wherein:

the hybrid circuit further comprises a second filter circuit having a first terminal connected to a second line of the differential communications line, a second terminal connected to a second line of the differential output of the transmitter and a third terminal connected to a second line of the differential input of the receiver, the second filter circuit being configured as a voltage divider formed from reactive elements for substantially canceling signals transmitted by the transmitter and appearing on the second line of the differential output thereof from appearing at the second line of the differential input of the receiver.

36. (Previously Presented) The device of claim 35, wherein:

the second filter circuit forms a capacitive divider.

37. (Previously Presented) The device of claim 35, wherein:
the second filter circuit comprises a pair of series connected capacitors connected between the second line of the differential pair of communications lines and the second line of the differential output of the transmitter, and a resistor having a first terminal connected to each of the capacitors and a second terminal connected to a reference voltage.
38. (Previously Presented) The device of claim 35, wherein:
the second filter circuit comprises a first order, high pass filter.
39. (Previously Presented) The device of claim 35, wherein:
the first filter circuit and the second filter circuit each comprise a first order high pass filter.
40. (Previously Presented) The device of claim 34, wherein:
the first filter circuit forms a capacitive divider.
41. (Previously Presented) The device of claim 34, wherein:
the first filter circuit comprises a pair of series connected capacitors connected between the first line of the differential pair of communications lines and the second line of the differential output of the transmitter, and a resistor having a first terminal connected to each of the capacitors and a second terminal connected to a reference voltage.
42. (Previously Presented) The device of claim 34, wherein:
the hybrid circuit further comprises an amplifier circuit configured as an inverting amplifier that is connected between the transmitter output and the first filter circuit, the amplifier circuit and the first filter circuit generating a first scaled output voltage signal and a second scaled voltage signal which cancel each other at the receiver input.

43. (Previously Presented) A hybrid circuit associated with an end of a two wire telecommunications line to which a differential transmitter and a differential receiver are connected, comprising:

a first circuit forming a voltage divider of reactive elements that is configured as a filter having a first terminal coupled to a first differential output of the transmitter, a second terminal coupled to a first differential input of the receiver and a third terminal coupled to a first wire of the telecommunications line;

a second circuit forming a voltage divider of reactive elements that is configured as a filter having a first terminal connected to a second differential output of the transmitter, a second terminal connected to a second differential input of the receiver, and a third terminal connected to a second wire of the telecommunications line;

the first and second circuits canceling signals transmitted by the transmitter from appearing at the receiver input and filtering signals at predetermined frequencies on the telecommunications line from appearing at the receiver input so that the receiver is substantially isolated from the transmitter.

44. (Previously Presented) The hybrid circuit of claim 43, wherein:

the second circuit capacitively scales signals appearing at the second output of the transmitter and signals appearing on the second wire of the telecommunications line so that common signals therebetween cancel at the second input of the receiver.

45. (Previously Presented) The hybrid circuit of claim 43, wherein:

the first circuit capacitively scales signals appearing at the first output of the transmitter and signals appearing on the first wire of the telecommunications line so that common signals therebetween cancel at the second input of the receiver.

46. (Previously Presented) A hybrid circuit associated with an end of a telecommunications line to which a transmitter and a receiver are connected, comprising:

a first circuit comprising:

a first capacitor having a first terminal connected to the telecommunications line and a second terminal;

a second capacitor having a first terminal connected to the transmitter output and a second terminal connected to the second terminal of the first capacitor; and

a resistor connected between to the second terminal of the first capacitor and a reference voltage;

the first circuit operable to cancel signals transmitted by the transmitter from appearing at the receiver input and filter signals at predetermined frequencies on the telecommunications line from appearing at the receiver input so that the receiver is substantially isolated from the transmitter.

47. (Previously Presented) The hybrid circuit of claim 46, wherein:
the first circuit comprises a high pass filter.

48. (Previously Presented) The hybrid circuit of claim 46, wherein:
the first circuit capacitively scales signals appearing at the output of the transmitter and on the telecommunications line so as to substantially cancel common signals therebetween.

49. (Previously Presented) The hybrid circuit of claim 46, wherein:
the first circuit is configured as a high pass filter.

50. (Previously Presented) The hybrid circuit of claim 46, wherein:
the ratio between the capacitance value of the first capacitor to the capacitance value of the second capacitor is substantially the same as the voltage swing of signals at the transmitter output to the voltage swing of related signals appearing on the telecommunications line.

51. (Previously Presented) The hybrid circuit of claim 46, further comprising:
a second circuit configured as an inverting amplifier, the second circuit connected between the transmitter output and an input of the first circuit.

52. (Previously Presented) A device for transmitting and receiving signals over a two wire communications line, comprising:

a differential transmitter circuit having a first and second outputs;
a differential receiver circuit having a first and second inputs; and
a hybrid circuit connected to the transmitter outputs, the receiver inputs and the two wire communications line, the hybrid circuit comprising:

a first voltage divider formed from reactive elements for substantially canceling signals transmitted by the first output of the differential transmitter circuit from appearing at the first input of the differential receiver circuit; and

a second voltage divider formed from reactive elements for substantially canceling signals transmitted by the second output of the differential transmitter circuit from appearing at the second input of the differential receiver circuit.

53. (Previously Presented) The device of claim 52, wherein each of the first and second voltage dividers is formed from a resistive voltage divider connected between one wire of the communications line and one of the differential transmitter outputs with a divider node of the resistive voltage divider connected to one of the differential receiver inputs, and further including a capacitor connected between the divider node and a reference voltage.

54. (Previously Presented) The device of claim 52, wherein each of the first and second voltage dividers is formed from a capacitive voltage divider connected between one wire of the communications line and one of the differential transmitter outputs with a divider node of the capacitive voltage divider connected to one of the differential receiver inputs, and further including a resistor connected between the divider node and a reference voltage.

55. (Previously Presented) A device for transmitting and receiving xDSL signals over a communications line, the xDSL signals possessing first and second non-overlapping transmission bandwidths, comprising:

a transmitter circuit having an output coupled to the communications line for transmitting xDSL signals in the first bandwidth;

a receiver circuit having an input coupled to the communications line for receiving xDSL signals in the second bandwidth; and

a hybrid circuit connected between the transmitter output, the receiver input and the communications line, the hybrid circuit being configured as a voltage divider and filter circuit formed from reactive elements for substantially canceling first bandwidth signals transmitted by the transmitter circuit from appearing with second bandwidth signals at the receiver input and further filtering out first bandwidth signals that are not substantially canceled.

56. (Previously Presented) The device of claim 55, wherein the voltage divider and filter circuit comprises a first order filter.

57. (Previously Presented) The device of claim 55, wherein the voltage divider and filter circuit implements high pass filtering.

58. (Previously Presented) The device of claim 55, wherein the voltage divider and filter circuit includes a capacitive voltage divider, with a connected resistor to form the filter.

59. (Previously Presented) The device of claim 55, wherein the voltage divider and filter circuit includes a resistive voltage divider, with a connected capacitor to form the filter.

60. (Previously Presented) The device of claim 55, wherein:

the communications line comprises a two wire communications line;

the transmitter output is a differential output;

the receiver input is a differential input; and

the hybrid circuit comprises:

a first voltage divider and filter circuit connected between a first wire of the communications line, a first line of the differential transmitter output and a first line of the differential receiver input to substantially cancel and filter signals transmitted from the first line of the differential transmitter output from appearing at the first line of the differential receiver input; and

a second voltage divider and filter circuit connected between a second wire of the communications line, a second line of the differential transmitter output and a second line of the differential receiver input to substantially cancel and filter signals transmitted from the second line of the differential transmitter output from appearing at the second line of the differential receiver input.

61. (Previously Presented) The device of claim 55, wherein:

the hybrid circuit further comprises an amplifier circuit configured as an inverting amplifier that is connected between the transmitter output and the voltage divider and filter circuit to generate a first scaled output voltage signal which is substantially canceled at the receiver input by a second scaled voltage signal generated by the voltage divider and filter circuit.

62. (Previously Presented) A device for transmitting and receiving signals over a communications line, comprising:

a transmitter circuit having an output coupled to the communications line;

a receiver circuit having an input coupled to the communications line;

a hybrid circuit connected to the transmitter circuit output, the receiver circuit input and the communications line, for filtering signals received from the communications line at frequencies that fall outside of a predetermined frequency range, the hybrid circuit being configured as a voltage divider formed from reactive elements for substantially canceling signals transmitted by the transmitter circuit from appearing at the receiver input; and

an amplifier circuit configured as an inverting amplifier that is connected between the transmitter circuit output and the hybrid circuit, the amplifier circuit and the hybrid circuit generating a first scaled output voltage signal and a second scaled voltage signal which cancel each other at the receiver circuit input.